



Northeast Fisheries Science Center Reference Document 23-10

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This report provides estimated bycatch of 7 species of small cetaceans and pinnipeds bycaught in the New England gillnet (NEG) and Mid-Atlantic gillnet (MAG) fisheries. The bycatch estimation approach used for prior year estimates was modified because only limited and non-representative observer data was available in 2020 and 2021 due to the COVID-19 pandemic (Precoda and Lyssikatos 2023). Instead of our standard approach of using each year's observer data to calculate bycatch rates for that year and extrapolating that to estimate total bycatch for the same year, we used observer data from 3 years prior to the pandemic (2017-2019) to estimate bycatch rates and applied those rates to the total fishing effort in 2020 and in 2021. This approach is described at more length in the Methods section. For additional details on the bycatch estimation methodology, please refer to Orphanides and Hatch (2017) and Precoda and Orphanides (2022).

Bycatch estimates in New England were performed with a stratified ratio estimation approach using the seasons, port groups, and management areas used in recent years (Orphanides and Hatch 2017; management areas are shown in Figure 1). This time-area stratification approach was originally developed for the estimation of harbor porpoise (*Phocoena phocoena phocoena*) bycatch but has been applied to bycatch of other small cetaceans and pinnipeds since 1995 (Blaylock et al. 1995) because bycatch for other species is also largely driven by spatial and temporal patterns. The 2021 estimates for 2 rarely caught species, Risso's dolphin (*Grampus griseus*) and white-sided dolphin (*Lagenorhynchus acutus*), were replaced by the number of animals actually observed in 2021 in the NEG, as the bycatch rates based on 2017-2019 observations produced lower estimates than the bycatch reported by observers. Observed data from 2017-2019 and commercial fishing data from 2020 and 2021 are summarized in Table 1. The estimated 2020 serious injuries and total mortalities in the NEG fishery were 50 (CV = 0.25) common dolphins (*Delphinus delphis delphis*), 2 (CV = 0.99) bottlenose dolphins (*Tursiops truncatus truncatus*), 2 (CV = 1.01) Risso's dolphins (*Grampus griseus*), 121 (CV = 0.22) harbor porpoises, 72 (CV = 0.22) harp seals (*Pagophilus groenlandicus*), 261 (CV = 0.14) harbor seals (*Phoca vitulina vitulina*), and 1357 (CV = 0.14) gray seals (*Halichoerus grypus atlantica*). The estimated 2021 serious injuries and total mortalities in the NEG fishery were 39 (CV = 0.24) common dolphins, 1 (CV = 0.99) bottlenose dolphin, 3 (CV=0) Risso's dolphins, 111 (CV = 0.19) harbor porpoises, 66 (CV = 0.24) harp seals, 241 (CV = 0.13) harbor seals, 1027 (CV = 0.14) gray seals, and 2 (CV=0) white-sided dolphins. The NEG estimates are based on bycatch observed from 2017-2019 consisting of 31 common dolphins, 1 bottlenose dolphin, 1 Risso's dolphin, 61 harbor porpoises, 42 harp seals, 144 harbor seals, and 512 gray seals (Figure 2). Incidental takes of unknown species were excluded from the bycatch estimation; this included 54 unidentified seals and 9 unidentified dolphins. Animals excluded from the bycatch estimation (typically because of non-serious injuries, suspected death prior to being bycaught, or inshore location) included 1 gray seal. Bycatch observed in 2020 in the NEG fishery, which was not used in the estimation process because of low and nonrepresentative observer coverage, consisted of 2 common dolphins, 10 harbor porpoises, 4 harbor seals, 14 gray seals, and 1 unidentified seal; none of these were released alive. Bycatch observed in 2021 in the NEG fishery consisted of 2 white-sided dolphins, 3 common dolphins, 3 Risso's dolphins, 25 harbor porpoise, 24 harbor seals, 48 gray seals, and 8 unidentified seals. Again, none were released alive.

The Mid-Atlantic ratio estimator stratification was done as in recent years by area, mesh size, soak duration, and season coinciding with previous bycatch estimates in this region (Orphanides and Hatch 2017). The spatial stratifications for 2020 and 2021 Mid-Atlantic bycatch included the Waters off New Jersey (NJ) and Southern Mid-Atlantic (SMA) Harbor Porpoise Take Reduction Plan (HPTRP) management areas (Figure 1). Seasons used were based on current and

observed historical bycatch from 1994-2019 and were Dec-Mar (NJ) and Dec-Mar (SMA) for common dolphin; Dec-May (NJ) and Dec-May (SMA) for gray seal; May-Aug (NJ) and Jan-Apr (SMA) for harbor porpoise; Dec-May (NJ) for harbor seal; and Dec-May (NJ) for harp seal.

The estimated 2020 total serious injuries and mortalities in the MAG fishery were 30 (CV = 0.55) common dolphins, 9 (CV = 0.72) gray seals, 16 (CV = 0.63) harbor porpoises, 9 (CV = 0.43) harbor seals, and 2 (CV = 1.01) harp seals (Table 11). The estimated 2021 total serious injuries and mortalities in the MAG fishery were 24 (CV = 0.53) common dolphins, 7 (CV = 0.69) gray seals, 10 (CV = 0.65) harbor porpoises, 9 (CV = 0.40) harbor seals, and 2 (CV = 1.01) harp seals (Table 12). The MAG estimates are based on bycatch observed from 2017-2019 consisting of 6 common dolphins, 3 harbor porpoises, 3 harp seals, 7 harbor seals, and 3 gray seals (Figure 2). Incidental takes of unknown species were not included in the bycatch estimation; this included 1 unidentified marine mammal, 1 unidentified dolphin, and 1 unidentified porpoise/dolphin. Animals excluded from the bycatch estimation were 6 bottlenose dolphins from coastal stocks, which are reported elsewhere (Lyssikatos 2022). Bycatch observed in 2020 in the MAG fishery, which was not used in the estimation process because of low and nonrepresentative observer coverage, was 1 harbor porpoise and 2 harbor seals; none of these were released alive. No bycatch was observed in the MAG fishery in 2021.

METHODS

The bycatch estimation methodology is based on Orphanides and Hatch (2017) and Precoda and Orphanides (2022). The major modification to the methodology documented in those references was driven by the limited observer coverage in 2020 and 2021, because of the Covid-19 pandemic, and the resulting nonrepresentativeness of the observer data of the fisheries (Precoda and Lyssikatos 2023). Rather than use observer data from 2020 and 2021 to calculate bycatch rates, we assumed better estimates could be obtained from older observer data representing the fisheries as they were in prior years. We performed a sensitivity analysis of the bycatch estimates using from 1 to 6 prior years of observer data (see Appendix). Based on that analysis, we chose to pool the 3 most recent available years of pre-pandemic observer data. A period of 3 years balances the goals of controlling the interannual variability seen in the observer data while minimizing any real effects that might be caused by changes in the fishery or animal distribution or animal abundance over a longer period of time. Bycatch rates calculated from pooled 2017-2019 observer data were then applied to commercial fishing effort in 2020 and in 2021 to estimate total bycatch in 2020 and in 2021. We calculated the mean annual bycatch over the 5-year period of 2017-2021 with the bycatch estimates for all 5 years, but because using past observer data does not add new information, we calculated the CV of the mean annual bycatch over only 2017-2019 (i.e., treated the CVs from 2020 and 2021 as missing; Table 13 [B, C]; cf. Bettridge 2023).

In the NEG in 2021, there were 2 species reported bycaught by observers which are rarely bycaught: Risso's dolphin and white-sided dolphin. The bycatch estimates produced by the above approach were lower than the actual number of bycaught animals seen by observers, which may indicate the limits of using observer data from 2017-2019 for especially rarely caught species. These estimates are not presented and have been replaced with the actual number observed, with CV=0, in Table 13 (B) and in the calculations of the 5-year mean annual bycatch and its CV.

In 2020 and 2021, there were no records of observed marine mammal interactions in New England or Mid-Atlantic gillnet fisheries in which the animal was released alive, likely because of reduced observer coverage due to COVID-19 restrictions. The mean annual bycatch estimates for

2020 and 2021 were apportioned between seriously injured animals and mortalities using the fractions of seriously injured animals and mortalities over the period 2017-2019 (Josephson 2022).

Other minor modifications made this year include small bug fixes and code improvements completed during a reimplementation of the code that processes the data and estimates bycatch.

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TABLES

Table 1. Summaries of observed hauls, observed trips, commercial trips, observed landings, and prorated commercial landings by season and port group (P) or management area (MA) for the New England gillnet fishery (Figure 1a). Observer data is from 2017-2019, and commercial data is from 2020-2021. The seasons were defined as “F” (fall; September-December), “S” (summer; June-August), and “W” (winter; January-May).

Season	Area	Observed Hauls ^a	Observed Trips ^b	Commercial Trips		Observed Landings (mt)	Commercial Landings (mt)	
				2020	2021		2020	2021
	Cape Cod South (MA)	369 (197)	107	265	160	187.67	1004.25	670.03
	Cashes Ledge (MA)	0 (0)	0	1	0	0.00	4.84	0.00
	East of Cape Cod (P)	48 (22)	12	21	26	25.69	121.62	153.11
	Massachusetts Bay (MA)	3 (0)	1	11	3	0.20	0.78	2.65
	Mid-Coast (MA)	269 (69)	65	86	88	64.49	78.18	114.23
	New Hampshire (P)	0 (0)	0	0	2	0.00	0.00	0.33
W	North of Boston (P)	7 (0)	4	2	18	1.01	7.20	40.25
	Offshore (MA)	184 (88)	22	12	16	48.33	34.23	32.35
	Offshore (P)	66 (43)	8	3	2	21.46	3.04	7.39
	South of Boston (P)	0 (0)	0	0	1	0.00	0.00	0.45
	South of Cape Cod (P)	27 (9)	14	61	45	7.55	149.32	72.58
	Southern Maine (P)	71 (51)	12	4	18	14.53	1.56	40.47
	Southern New England (MA)	1308 (656)	281	413	277	914.61	1723.38	1218.28

Season	Area	Observed Hauls ^a	Observed Trips ^b	Commercial Trips		Observed Landings (mt)	Commercial Landings (mt)	
				2020	2021		2020	2021
	Stellwagen Bank (MA)	288 (82)	80	57	47	40.65	19.52	22.09
	Subtotal	2640 (1217)	560	936	703	1326.17	3147.91	2374.22
	East of Cape Cod (P)	379 (4)	163	1401	834	566.69	4189.23	2581.59
	Maryland (P)	0 (0)	0	1	0	0.00	0.10	0.00
	New Hampshire (P)	335 (0)	88	286	253	169.36	444.63	336.98
	North of Boston (P)	174 (0)	56	119	124	76.34	129.66	213.32
S	Northeast Closure (MA)	0 (0)	0	3	0	0.00	10.21	0.00
	Offshore (P)	176 (4)	22	38	15	62.68	89.12	51.37
	South of Boston (P)	185 (0)	45	99	88	35.82	80.10	82.76
	South of Cape Cod (P)	739 (0)	187	572	350	234.17	1673.23	930.38
	Southern Maine (P)	278 (0)	60	22	62	95.30	16.62	129.33
	Subtotal	2266 (8)	614	2541	1726	1240.34	6632.89	4325.74
	Cape Cod South (MA)	188 (101)	43	27	31	119.95	94.49	155.78
	East of Cape Cod (P)	441 (252)	189	688	437	649.80	2497.16	1250.77
	Massachusetts Bay (MA)	1 (0)	1	0	13	0.06	0.00	15.03
F	Mid-Coast (MA)	713 (185)	183	177	221	220.56	257.94	334.02
	New Hampshire (P)	98 (57)	24	55	25	30.23	52.32	26.73
	North of Boston (P)	90 (31)	31	35	82	33.01	79.10	114.04

Season	Area	Observed Hauls ^a	Observed Trips ^b	Commercial Trips		Observed Landings (mt)	Commercial Landings (mt)	
				2020	2021		2020	2021
	Offshore (MA)	75 (25)	8	2	2	33.94	1.63	5.42
	Offshore (P)	73 (13)	7	10	5	20.34	35.31	12.37
	South of Boston (P)	87 (35)	21	4	16	26.58	3.13	25.28
	South of Cape Cod (P)	1012 (284)	193	328	220	316.40	542.81	308.71
	Southern Maine (P)	153 (67)	23	23	20	74.27	77.19	49.28
	Southern New England (MA)	139 (60)	40	34	19	114.83	90.68	72.48
	Stellwagen Bank (MA)	49 (13)	18	11	6	13.28	6.57	5.24
	Subtotal	3119 (1123)	751	1394	1097	1653.25	3756.31	2375.14
	Total	8025 (2348)	1923	4871	3526	4219.77	13537.12	9075.10

^aThe number preceding the parentheses indicates the total observed hauls (i.e., complete hauls + limited hauls). The number in parentheses is the number of limited hauls. During complete sampling, observers do not explicitly watch haulbacks and may fail to see bycatch of marine mammals that fall out of the net prior to being hauled on board. During limited sampling, the observer watches the net during haulbacks, reducing the chance of unnoticed bycatch.

^bThe subtotal and total rows may be slightly smaller than the sum of the observed trips across areas and seasons. This is because an observed trip may include hauls in different areas and/or seasons, while subtotals and totals include only unique trips.

Table 2. Observed total number of bycatch from 2017-2019, estimated bycatch rate per metric ton landed in same period, estimated bycatch in 2020 and 2021, coefficient of variation (CV), and 95% confidence interval (CI) of common dolphin (*Delphinus delphis delphis*) bycatch in the 2020 and 2021 New England gillnet fishery by season and port group (P) or management area (MA). The seasons were defined as “W” (winter; January-May) and “F” (fall; September-December).

Season	Area	Observed Bycatch (2017-2019)	Bycatch Rate	2020			2021		
				Estimated Bycatch	CV	95% CI	Estimated Bycatch	CV	95% CI
W	Southern New England (MA)	17	0.019	33.09	0.32	16-61	23.39	0.32	11-43
	Subtotal	17	-	33.09	0.32	16-61	23.39	0.32	11-43
F	Cape Cod South (MA)	3	0.025	2.34	0.58	0-7	3.86	0.58	1-11
	Mid-Coast (MA)	2	0.009	2.46	1.00	0-15	2.97	1.00	0-18
	South of Boston (P)	1	0.071	0.22	0.88	0-1	1.80	0.88	0-7
	South of Cape Cod (P)	6	0.02	10.62	0.61	2-36	6.04	0.61	1-21
	Southern New England (MA)	2	0.018	1.67	0.74	0-7	1.33	0.74	0-5
	Subtotal	14	-	17.31	0.42	7-42	16.01	0.35	7-33
Total		31	-	50.40	0.25	30-83	39.40	0.24	24-63

Table 3. Observed total number of bycatch from 2017-2019, estimated bycatch rate per metric ton landed in same period, estimated bycatch in 2020 and 2021, coefficient of variation (CV), and 95% confidence interval (CI) of bottlenose dolphin (*Tursiops truncatus truncatus*) bycatch in the 2020 and 2021 New England gillnet fishery by season and port group (P) or management area (MA). The season was defined as “W” (winter; January-May).

Season	Area	Observed Bycatch (2017-2019)	Bycatch Rate	2020			2021		
				Estimated Bycatch	CV	95% CI	Estimated Bycatch	CV	95% CI
W	Southern New England (MA)	1	0.001	2.02	0.99	0-12	1.43	0.99	0-8
	Subtotal	1	-	2.02	0.99	0-12	1.43	0.99	0-8
Total		1	-	2.02	0.99	0-12	1.43	0.99	0-8

Table 4. Observed total number of bycatch from 2017-2019, estimated bycatch rate per metric ton landed in same period, estimated bycatch in 2020, coefficient of variation (CV), and 95% confidence interval (CI) of Risso’s dolphin (*Grampus griseus*) bycatch in the 2020 New England gillnet fishery by season and port group (P) or management area (MA). The season was defined as “W” (winter; January-May).

Season	Area	Observed Bycatch (2017-2019)	Bycatch Rate	2020 Estimated Bycatch	CV	95% CI
W	Southern New England (MA)	1	0.001	1.96	1.01	0-12
	Subtotal	1	-	1.96	1.01	0-12
Total		1	-	1.96	1.01	0-12

Table 5. Observed total number of bycatch from 2017-2019, estimated bycatch rate per metric ton landed in same period, estimated bycatch in 2020 and 2021, coefficient of variation (CV), and 95% confidence interval (CI) of harbor porpoise (*Phocoena phocoena phocoena*) bycatch in the 2020 and 2021 New England gillnet fishery by season and port group (P) or management area (MA). The seasons were defined as “W” (winter; January-May), “S” (summer; June-August), and “F” (fall; September-December).

Season	Area	Observed Bycatch (2017-2019)	Bycatch Rate	2020			2021		
				Estimated Bycatch	CV	95% CI	Estimated Bycatch	CV	95% CI
W	Cape Cod South (MA)	10	0.060	60.37	0.38	27-127	40.28	0.38	18-85
	Mid-Coast (MA)	10	0.157	12.28	0.62	3-42	17.94	0.62	5-62
	Offshore (MA)	4	0.091	3.13	0.56	0-8	2.96	0.56	0-8
	Offshore (P)	1	0.046	0.14	1.00	0-1	0.34	1.00	0-2
	Southern New England (MA)	9	0.01	17.16	0.37	7-35	12.13	0.37	5-25
	Stellwagen Bank (MA)	1	0.025	0.48	0.97	0-3	0.54	0.97	0-3
	Subtotal	35	-	93.55	0.26	55-158	74.18	0.26	44-123
S	North of Boston (P)	1	0.011	1.40	1.03	0-9	2.30	1.03	0-15
	Offshore (P)	1	0.016	1.42	1.02	0-8	0.82	1.02	0-5
	Southern Maine (P)	3	0.032	0.54	0.53	0-2	4.18	0.53	1-12
	Subtotal	5	-	3.36	0.62	0-12	7.30	0.46	2-19
F	Cape Cod South (MA)	3	0.025	2.35	0.62	0-7	3.88	0.62	1-12

Season	Area	Observed Bycatch (2017-2019)	Bycatch Rate	2020			2021		
				Estimated Bycatch	CV	95% CI	Estimated Bycatch	CV	95% CI
	Mid-Coast (MA)	17	0.076	20.88	0.33	10-41	25.27	0.33	13-50
	Southern New England (MA)	1	0.006	0.58	1.54	0-4	0.47	1.54	0-4
	Subtotal	21	-	23.82	0.30	13-44	29.62	0.30	16-54
	Total	61	-	120.72	0.22	79-185	111.10	0.19	76-163

Table 6. Observed total number of bycatch from 2017-2019, estimated bycatch rate per metric ton landed in same period, estimated bycatch in 2020 and 2021, coefficient of variation (CV), and 95% confidence interval (CI) of harp seal (*Pagophilus groenlandicus*) bycatch in the 2020 and 2021 New England gillnet fishery by season and port group (P) or management area (MA). The season was defined as “W” (winter; January-May).

Season	Area	Observed Bycatch (2017-2019)	Bycatch Rate	2020			2021		
				Estimated Bycatch	CV	95% CI	Estimated Bycatch	CV	95% CI
W	Cape Cod South (MA)	1	0.005	4.92	1.01	0-30	3.28	1.01	0-20
	Mid-Coast (MA)	9	0.138	10.81	0.54	3-30	15.79	0.54	4-44
	Offshore (MA)	2	0.052	1.80	0.67	0-6	1.70	0.67	0-6
	Southern Maine (P)	1	0.159	0.25	1.34	0-2	6.44	1.34	0-34
	Southern New England (MA)	29	0.032	54.42	0.26	32-90	38.47	0.26	22-64
	Subtotal	42	-	72.19	0.22	45-111	65.68	0.24	39-103
	Total	42	-	72.19	0.22	45-111	65.68	0.24	39-103

Table 7. Observed total number of bycatch from 2017-2019, estimated bycatch rate per metric ton landed in same period, estimated bycatch in 2020 and 2021, coefficient of variation (CV), and 95% confidence interval (CI) of harbor seal (*Phoca vitulina vitulina*) bycatch in the 2020 and 2021 New England gillnet fishery by season and port group (P) or management area (MA). The seasons were defined as “W” (winter; January-May), “S” (summer; June-August), and “F” (fall; September-December).

Season	Area	Observed Bycatch (2017-2019)	Bycatch Rate	2020			2021		
				Estimated Bycatch	CV	95% CI	Estimated Bycatch	CV	95% CI
W	Cape Cod South (MA)	6	0.029	29.50	0.48	9-72	19.68	0.48	6-48
	Mid-Coast (MA)	8	0.123	9.58	0.50	3-20	14.00	0.50	5-30
	Offshore (MA)	2	0.039	1.33	1.20	0-8	1.26	1.20	0-7
	Southern New England (MA)	19	0.02	34.27	0.31	18-63	24.22	0.31	12-45
	Stellwagen Bank (MA)	2	0.049	0.96	0.65	0-3	1.09	0.65	0-4
	Subtotal	37	-	75.64	0.24	46-121	60.25	0.23	38-93
S	New Hampshire (P)	2	0.011	4.92	0.73	0-19	3.73	0.73	0-14

Season	Area	Observed Bycatch (2017-2019)	Bycatch Rate	2020			2021		
				Estimated Bycatch	CV	95% CI	Estimated Bycatch	CV	95% CI
	North of Boston (P)	4	0.043	5.59	0.49	1-14	9.19	0.49	2-22
	Offshore (P)	5	0.08	7.11	0.52	1-18	4.10	0.52	0-10
	South of Cape Cod (P)	3	0.013	21.53	0.99	0-124	11.97	0.99	0-69
	Southern Maine (P)	7	0.075	1.25	0.39	0-3	9.70	0.39	4-20
	Subtotal	21	-	40.40	0.55	15-138	38.70	0.35	21-94
	Cape Cod South (MA)	3	0.025	2.37	0.90	0-12	3.90	0.90	0-19
	East of Cape Cod (P)	10	0.015	38.13	0.43	15-88	19.10	0.43	7-44
	Mid-Coast (MA)	52	0.232	63.93	0.21	41-97	77.39	0.21	50-117
	New Hampshire (P)	7	0.267	13.94	0.47	3-32	7.13	0.47	1-17
F	North of Boston (P)	9	0.279	22.09	0.41	9-48	31.85	0.41	13-70
	Offshore (MA)	1	0.029	0.05	1.28	0-1	0.16	1.28	0-1
	Southern Maine (P)	2	0.034	2.59	1.00	0-12	1.65	1.00	0-8
	Southern New England (MA)	2	0.018	1.67	0.79	0-7	1.33	0.79	0-6
	Subtotal	86	-	144.77	0.17	104-204	142.50	0.16	102-195
	Total	144	-	260.80	0.14	199-352	241.45	0.13	188-308

Table 8. Observed total number of bycatch from 2017-2019, estimated bycatch rate per metric ton landed in same period, estimated bycatch in 2020 and 2021, coefficient of variation (CV), and 95% confidence interval (CI) of gray seal (*Halichoerus grypus atlantica*) bycatch in the 2020 and 2021 New England gillnet fishery by season and port group (P) or management area (MA). The seasons were defined as “W” (winter; January-May), “S” (summer; June-August), and “F” (fall; September-December).

Season	Area	Observed Bycatch (2017-2019)	Bycatch Rate	2020			2021		
				Estimated Bycatch	CV	95% CI	Estimated Bycatch	CV	95% CI
W	Cape Cod South (MA)	85	0.429	430.82	0.37	249-1123	287.44	0.37	166-749

Season	Area	Observed Bycatch (2017-2019)	Bycatch Rate	2020			2021		
				Estimated Bycatch	CV	95% CI	Estimate d Bycatch	CV	95% CI
	Mid-Coast (MA)	13	0.189	14.75	0.45	5-31	21.55	0.45	8-45
	Offshore (MA)	13	0.294	10.06	0.66	1-31	9.51	0.66	1-29
	Southern New England (MA)	193	0.208	357.75	0.16	260-498	252.90	0.16	183-352
	Stellwagen Bank (MA)	2	0.049	0.96	1.02	0-6	1.09	1.02	0-7
	Subtotal	306	-	814.34	0.21	595-1360	572.49	0.20	424-930
S	East of Cape Cod (P)	17	0.03	126.87	0.28	69-214	78.19	0.28	43-132
	New Hampshire (P)	5	0.028	12.30	0.54	2-34	9.32	0.54	2-26
	North of Boston (P)	25	0.52	67.36	0.64	15-219	110.82	0.64	26-360
	Offshore (P)	7	0.112	9.95	0.68	1-34	5.74	0.68	0-20
	South of Boston (P)	3	0.081	6.47	1.03	0-36	6.69	1.03	0-38
	South of Cape Cod (P)	7	0.031	51.88	0.73	8-211	28.85	0.73	4-118
	Southern Maine (P)	15	0.166	2.75	0.44	1-7	21.43	0.44	8-49
	Subtotal	79	-	277.59	0.25	175-453	261.03	0.30	154-477
F	Cape Cod South (MA)	19	0.157	14.84	0.36	7-30	24.46	0.36	11-49
	East of Cape Cod (P)	45	0.069	171.59	0.21	111-258	85.94	0.21	56-129
	Mid-Coast (MA)	39	0.174	48.09	0.24	30-79	58.21	0.24	36-96
	New Hampshire (P)	1	0.029	1.53	1.00	0-8	0.78	1.00	0-4
	North of Boston (P)	2	0.063	5.01	0.70	0-16	7.23	0.70	0-23
	South of Boston (P)	1	0.034	0.11	1.08	0-1	0.87	1.08	0-5
	South of Cape Cod (P)	8	0.027	14.50	0.52	4-40	8.25	0.52	2-23
	Southern Maine (P)	1	0.017	1.29	0.82	0-5	0.83	0.82	0-3
	Southern New England (MA)	11	0.091	8.22	0.65	1-23	6.57	0.65	1-19

Season	Area	Observed Bycatch (2017-2019)	Bycatch Rate	2020			2021		
				Estimated Bycatch	CV	95% CI	Estimated Bycatch	CV	95% CI
	Subtotal	127	-	265.17	0.15	196-354	193.13	0.13	147-249
	Total	512	-	1357.11	0.14	1092-1863	1026.65	0.14	822-1380

Table 9. Summaries of observed trips, commercial trips, observed landings, and prorated commercial landings by state for the Mid-Atlantic gillnet fishery (Figure 1b). Observer data is from 2017-2019. Effort in bays and sounds is not included.

State	Observed Trips	Commercial Trips (2020)	Commercial Trips (2021)	Observed Landings (mt)	Commercial Landings (2020, mt)	Commercial Landings (2021, mt)
Florida	0	55	50	0.00	5.24	4.17
Maryland	98	172	98	150.27	1283.81	749.32
Massachusetts	0	0	2	0	0	3.38
New Jersey	569	1229	1281	917.49	1986.20	1816.20
New York	96	172	119	118.29	205.55	176.19
North Carolina	715	4188	4337	462.69	2358.21	2027.44
Rhode Island	0	0	2	0	0	3.41
Virginia	493	1106	658	779.30	6151.05	4801.55
Total	1971	6922	6547	2428.04	11990.07	9581.67

Table 10. Summaries of observed hauls, observed trips, and observed landings from 2017-2019, and prorated commercial landings by species, season, region, mesh size and soak duration for strata with bycatch of common dolphin (*Delphinus delphis delphis*), gray seal (*Halichoerus grypus atlantica*), harbor porpoise (*Phocoena phocoena phocoena*), harbor seal (*Phoca vitulina vitulina*), and harp seal (*Pagophilus groenlandicus*) in the Mid-Atlantic gillnet fishery.

Species	Season	Region	Mesh Size (in)	Soak Duration (hrs)	Observed Hauls ^a	Observed Trips	Observed Landings (mt)	Commercial Landings (2020, mt)	Commercial Landings (2021, mt)
common dolphin	Dec-Mar	Waters off New Jersey	>= 7	> 72	168 (26)	50	97.24	87.74	101.03

Species	Season	Region	Mesh Size (in)	Soak Duration (hrs)	Observed Hauls ^a	Observed Trips	Observed Landings (mt)	Commercial Landings (2020, mt)	Commercial Landings (2021, mt)
common dolphin	Dec-Mar	Waters off New Jersey	≥ 7	≤ 72	321 (67)	99	161.19	482.69	431.57
common dolphin	Dec-Mar	Southern Mid-Atlantic	< 7	≤ 72	3805 (961)	710	1065.81	7042.78	5325.73
gray seal	Dec-May	Waters off New Jersey	≥ 7	> 72	260 (26)	82	173.09	106.69	128.07
gray seal	Dec-May	Waters off New Jersey	≥ 7	≤ 72	556 (67)	178	322.69	751.31	606.83
gray seal	Dec-May	Southern Mid-Atlantic	< 7	≤ 72	5101 (1579)	920	1202.02	7575.54	5651.42
harbor porpoise	May-Aug	Waters off New Jersey	≥ 7	≤ 72	300 (0)	99	220.81	465.95	199.62
harbor porpoise	Jan-Apr	Southern Mid-Atlantic	< 7	≤ 72	4153 (1114)	730	937.87	6600.13	4219.44
harbor seal	Dec-May	Waters off New Jersey	≥ 7	> 72	260 (26)	82	173.09	106.69	128.07
harbor seal	Dec-May	Waters off New Jersey	≥ 7	≤ 72	556 (67)	178	322.69	751.31	606.83
harp seal	Dec-May	Waters off New Jersey	≥ 7	> 72	260 (26)	82	173.09	106.69	128.07

^aThe number preceding the parentheses indicates the total observed hauls (i.e., complete hauls + limited hauls). The number in parentheses is the number of limited hauls. During complete sampling, observers do not explicitly watch haulbacks and may fail to see bycatch of marine mammals that fall out of the net prior to being hauled on board. During limited sampling, the observer watches the net during haulbacks, reducing the chance of unnoticed bycatch.

Table 11. Observed total number of bycatch from 2017-2019, estimated bycatch rate per metric ton landed, estimated bycatch in 2020, coefficient of variation (CV), and lower and upper limits on 95% confidence interval (CI) of estimated common dolphin (*Delphinus delphis delphis*), gray seal (*Halichoerus grypus atlantica*), harbor porpoise (*Phocoena phocoena phocoena*), harbor seal (*Phoca vitulina vitulina*), and harp seal (*Pagophilus groenlandicus*) bycatch in the 2020 Mid-Atlantic gillnet fishery, by season, region, mesh size and soak duration. Observer data is from 2017-2019

and commercial data is from 2020. Total rows for each species estimate bycatch by merging the strata listed above them.

Species	Season	Region	Mesh Size (in)	Soak Duration (hrs)	Observed Bycatch (2017-2019)	Bycatch Rate	2020 Estimated Bycatch	CV	95% CI
common dolphin	Dec-Mar	Waters off New Jersey	≥ 7	> 72	1	0.010	0.90	1.03	0-5
common dolphin	Dec-Mar	Waters off New Jersey	≥ 7	≤ 72	1	0.006	2.99	1.01	0-17
common dolphin	Dec-Mar	Southern Mid-Atlantic	< 7	≤ 72	4	0.004	26.43	0.62	6-82
common dolphin (total)	Dec-Mar				6	0.004	30.33	0.55	8-88
gray seal	Dec-May	Waters off New Jersey	≥ 7	> 72	1	0.006	0.62	0.99	0-3
gray seal	Dec-May	Waters off New Jersey	≥ 7	≤ 72	1	0.003	2.33	0.99	0-12
gray seal	Dec-May	Southern Mid-Atlantic	< 7	≤ 72	1	0.001	6.30	0.99	0-36
gray seal (total)	Dec-May				3	0.001	9.25	0.72	1-41
harbor porpoise	May-Aug	Waters off New Jersey	≥ 7	≤ 72	1	0.005	2.11	1.00	0-12
harbor porpoise	Jan-Apr	Southern Mid-Atlantic	< 7	≤ 72	2	0.002	14.07	0.71	0-49
harbor porpoise (total)				≤ 72	3	0.002	16.18	0.63	2-54
harbor seal	Dec-May	Waters off New Jersey	≥ 7	> 72	4	0.023	2.47	0.47	1-6
harbor seal	Dec-May	Waters off New Jersey	≥ 7	≤ 72	3	0.009	6.98	0.56	2-19
harbor seal (total)	Dec-May	Waters off New Jersey	≥ 7		7	0.011	9.45	0.43	4-21
harp seal	Dec-May	Waters off New Jersey	≥ 7	> 72	3	0.017	1.85	1.01	0-10

Table 12. Observed total number of bycatch from 2017-2019, estimated bycatch rate per metric ton landed, estimated bycatch in 2021, coefficient of variation (CV), and lower and upper limits on 95% confidence interval (CI) of estimated common dolphin (*Delphinus delphis delphis*), gray seal (*Halichoerus grypus atlantica*), harbor porpoise (*Phocoena phocoena phocoena*), harbor seal (*Phoca vitulina vitulina*), and harp seal (*Pagophilus groenlandicus*) bycatch in the 2021 Mid-Atlantic gillnet fishery, by season, region, mesh size and soak duration. Observer data is from 2017-2019 and commercial data is from 2021. Total rows for each species estimate bycatch by merging the strata listed above them.

Species	Season	Region	Mesh Size (in)	Soak Duration (hrs)	Observed Bycatch (2017-2019)	Bycatch Rate	2021 Estimated Bycatch	CV	95% CI
common dolphin	Dec-Mar	Waters off New Jersey	>= 7	> 72	1	0.010	1.04	1.03	0-6
common dolphin	Dec-Mar	Waters off New Jersey	>= 7	<= 72	1	0.006	2.68	1.01	0-15
common dolphin	Dec-Mar	Southern Mid-Atlantic	< 7	<= 72	4	0.004	19.99	0.62	5-62
common dolphin (total)	Dec-Mar				6	0.004	23.70	0.53	7-67
gray seal	Dec-May	Waters off New Jersey	>= 7	> 72	1	0.006	0.74	0.99	0-4
gray seal	Dec-May	Waters off New Jersey	>= 7	<= 72	1	0.003	1.88	0.99	0-10
gray seal	Dec-May	Southern Mid-Atlantic	< 7	<= 72	1	0.001	4.70	0.99	0-27
gray seal (total)	Dec-May				3	0.001	7.32	0.69	2-30
harbor porpoise	May-Aug	Waters off New Jersey	>= 7	<= 72	1	0.005	0.90	1.00	0-5
harbor porpoise	Jan-Apr	Southern Mid-Atlantic	< 7	<= 72	2	0.002	9.00	0.71	0-31
harbor porpoise (total)				<= 72	3	0.002	9.90	0.65	1-34
harbor seal	Dec-May	Waters off New Jersey	>= 7	> 72	4	0.023	2.96	0.47	1-7
harbor seal	Dec-May	Waters off New Jersey	>= 7	<= 72	3	0.009	5.64	0.56	2-15
harbor seal (total)	Dec-May	Waters off New Jersey	>= 7		7	0.012	8.60	0.40	4-18

Species	Season	Region	Mesh Size (in)	Soak Duration (hrs)	Observed Bycatch (2017-2019)	Bycatch Rate	2021 Estimated Bycatch	CV	95% CI
harp seal	Dec-May	Waters off New Jersey	>= 7	> 72	3	0.017	2.22	1.01	0-12

Table 13. Summaries for the 5-year period of 2017-2021. (A) Observer coverage by fishery and year. (B, C) Observed and estimated serious injuries and mortalities of marine mammals in the (B) New England gillnet and (C) Mid-Atlantic gillnet fisheries. The “Combined Estimate” is Estimated Mortality + Estimated Serious Injury. The annual estimated CVs for 2020 and 2021 were not used in calculating the CV of the mean annual bycatch. NA = not available.

(A) Observer coverage as fraction of metric tons landed by fishery and year.

Fishery	Years	Data Type	Observer Coverage (mt)
New England gillnet	2017-21	Obs. Data, Trip Logbook, Allocated Dealer Data	0.12, 0.11, 0.12, NA, NA
Mid-Atlantic gillnet	2017-21	Obs. Data, Trip Logbook, Allocated Dealer Data	0.09, 0.09, 0.13, NA, NA

(B) Observed and estimated serious injuries and mortalities of marine mammals in the New England gillnet fishery for 2017-2021. CV = coefficient of variation.

Species	Observed Serious Injury	Observed Mortality	Estimated Serious Injury	Estimated Mortality	Combined Estimate	Estimated CV	Mean (CV) Annual Combined
bottlenose dolphin (<i>Tursiops truncatus truncatus</i>)	0, 0, 0, 0, 0	1, 0, 0, 0, 0	0, 0, 0, 0, 0	8, 0, 0, 2, 1	8, 0, 0, 2, 1	0.92, 0, 0, 0.99, 0.99	2 (3.21)
common dolphin (<i>Delphinus delphis delphis</i>)	0, 0, 0, 0, 0	20, 10, 1, 2, 3	0, 0, 0, 0, 0	133, 93, 5, 50, 39	133, 93, 5, 50, 39	0.28, 0.45, 0.68, 0.25, 0.24	64 (0.29)
gray seal (<i>Halichoerus grypus atlantica</i>)	0, 0, 0, 0, 0	158, 103, 251, 14, 48	0, 0, 0, 0, 0	930, 1113, 2019, 1357, 1027	930, 1113, 2019, 1357, 1027	0.16, 0.32, 0.17, 0.14, 0.14	1289 (0.13)
harbor porpoise (<i>Phocoena phocoena phocoena</i>)	1, 0, 0, 0, 0	18, 9, 33, 10, 25	7, 0, 0, 2, 2	129, 92, 195, 119, 109	136, 92, 195, 121, 111	0.28, 0.52, 0.22, 0.22, 0.19	131 (0.19)
harbor seal (<i>Phoca vitulina vitulina</i>)	0, 0, 0, 0, 0	63, 22, 59, 4, 24	0, 0, 0, 0, 0	298, 188, 316, 261, 241	298, 188, 316, 261, 241	0.18, 0.36, 0.15, 0.14, 0.13	261 (0.13)
harp seal (<i>Pagophilus groenlandicus</i>)	0, 0, 0, 0, 0	6, 2, 34, 0, 0	0, 0, 0, 0, 0	44, 14, 163, 72, 66	44, 14, 163, 72, 66	0.37, 0.80, 0.19, 0.22, 0.24	72 (0.17)
Risso's dolphin (<i>Grampus griseus</i>)	0, 0, 0, 0, 0	0, 0, 1, 0, 3	0, 0, 0, 0, 0	0, 0, 5, 2, 3	0, 0, 5, 2, 3	0, 0, 0.70, 1.01, 0	2 (1.81)

Species	Observed Serious Injury	Observed Mortality	Estimated Serious Injury	Estimated Mortality	Combined Estimate	Estimated CV	Mean (CV) Annual Combined
white-sided dolphin (<i>Lagenorhynchus acutus</i>)	0, 0, 0, 0, 0	0, 0, 0, 0, 2	0, 0, 0, 0, 0	0, 0, 0, 0, 2	0, 0, 0, 0, 2	0, 0, 0, 0, 0	0 (NA)

(C) Observed and estimated serious injuries and mortalities of marine mammals in the Mid-Atlantic gillnet fishery for 2017-2021. CV = coefficient of variation.

Species	Observed Serious Injury	Observed Mortality	Estimated Serious Injury	Estimated Mortality	Combined Estimate	Estimated CV	Mean (CV) Annual Combined
common dolphin (<i>Delphinus delphis delphis</i>)	1, 0, 0, 0, 0	1, 1, 3, 0, 0	11, 0, 0, 5, 4	11, 8, 20, 25, 20	22, 8, 20, 30, 24	0.71, 0.91, 0.56, 0.55, 0.53	21 (0.33)
gray seal (<i>Halichoerus grypus atlantica</i>)	0, 0, 0, 0, 0	0, 0, 3, 0, 0	0, 0, 0, 0, 0	0, 0, 18, 9, 7	0, 0, 18, 9, 7	0, 0, 0.40, 0.72, 0.69	7 (1.07)
harbor porpoise (<i>Phocoena phocoena phocoena</i>)	0, 0, 0, 0, 0	1, 0, 2, 1, 0	0, 0, 0, 0, 0	9, 0, 13, 16, 10	9, 0, 13, 16, 10	0.95, 0, 0.51, 0.63, 0.65	10 (0.56)
harbor seal (<i>Phoca vitulina vitulina</i>)	0, 0, 0, 0, 0	1, 3, 3, 2, 0	0, 0, 0, 0, 0	3, 26, 17, 9, 9	3, 26, 17, 9, 9	0.62, 0.52, 0.35, 0.43, 0.40	13 (0.39)
harp seal (<i>Pagophilus groenlandicus</i>)	0, 0, 0, 0, 0	0, 0, 3, 0, 0	0, 0, 0, 0, 0	0, 0, 29, 2, 2	0, 0, 29, 2, 2	0, 0, 0.84, 1.01, 1.01	7 (3.71)

FIGURES

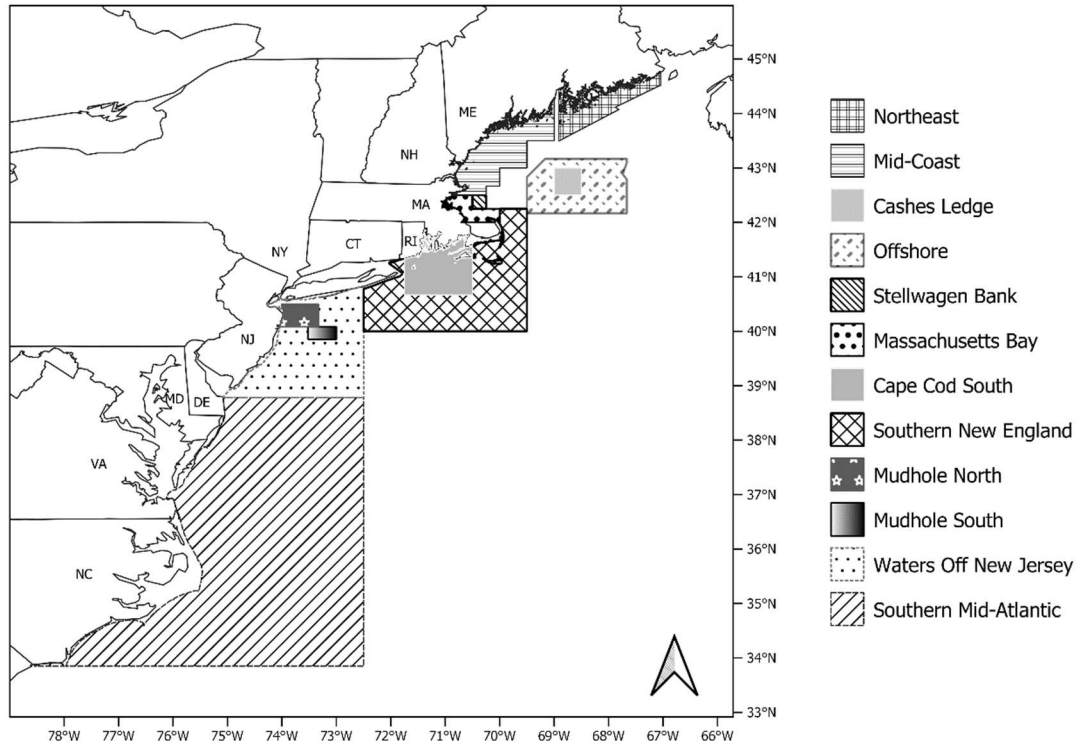


Figure 1. Management areas used in this report. For the purposes of estimating bycatch in the Mid-Atlantic gillnet fishery, Mudhole North and Mudhole South are considered part of the Waters Off New Jersey management area. Port groups, which reflect the port where the catch was landed, are not shown. Port groups are used for trips whose location was unknown, trips which fished outside the management areas, and trips which fished inside the management areas but outside the times when management measures were in place.

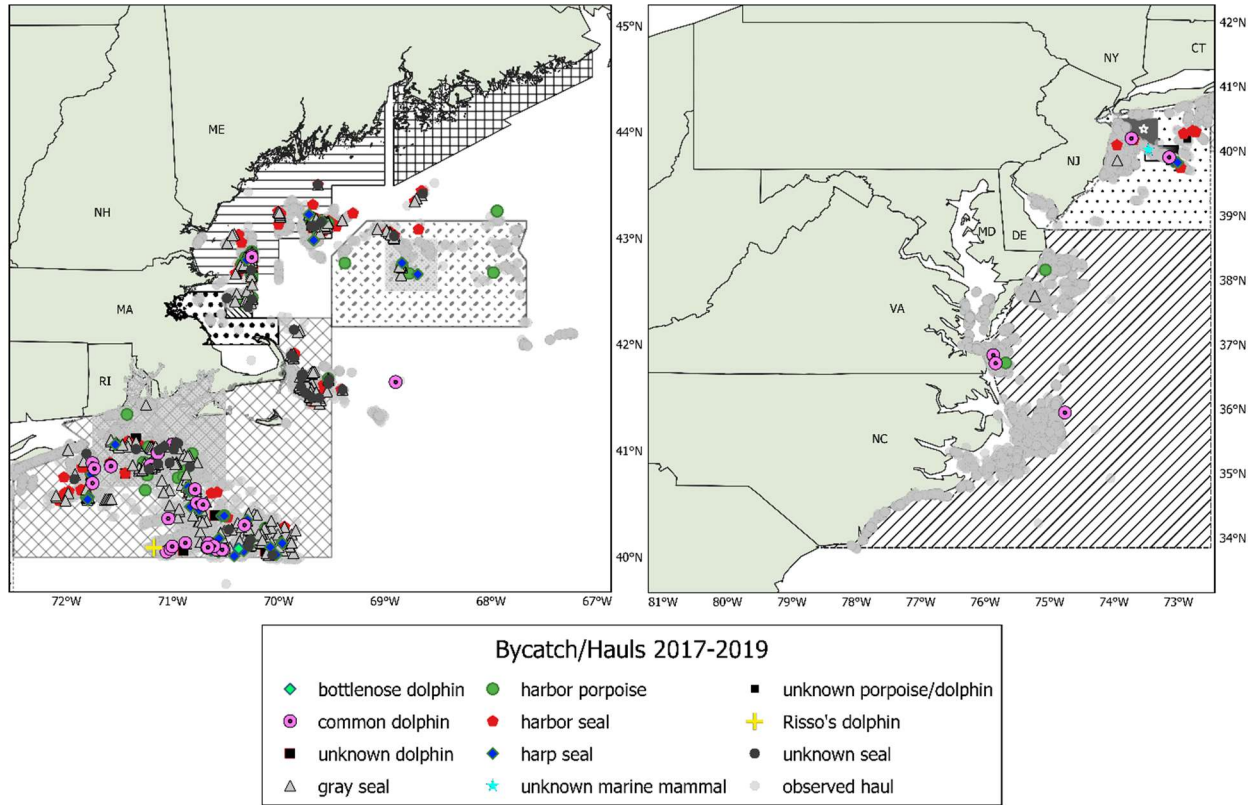


Figure 2. Locations of observed hauls and marine mammal bycatch in the 2017-2019 New England (top left) and Mid-Atlantic (top right) gillnet fisheries. Observed bycatch consisted of bottlenose dolphin (*Tursiops truncatus truncatus*), harbor porpoise (*Phocoena phocoena phocoena*), common dolphin (*Delphinus delphis delphis*), Risso's dolphin (*Grampus griseus*), gray seal (*Halichoerus grypus atlantica*), harbor seal (*Phoca vitulina vitulina*), harp seal (*Pagophilus groenlandicus*), and unknown species.

APPENDIX

We performed sensitivity analyses of the bycatch estimates to bycatch rates calculated from 1 to 6 prior years of observer data; results are shown in the figures below. For most species, the estimates vary little when the observer data covers 3 to 6 years; the differences are greatest for species which have no observed bycatch in some years.

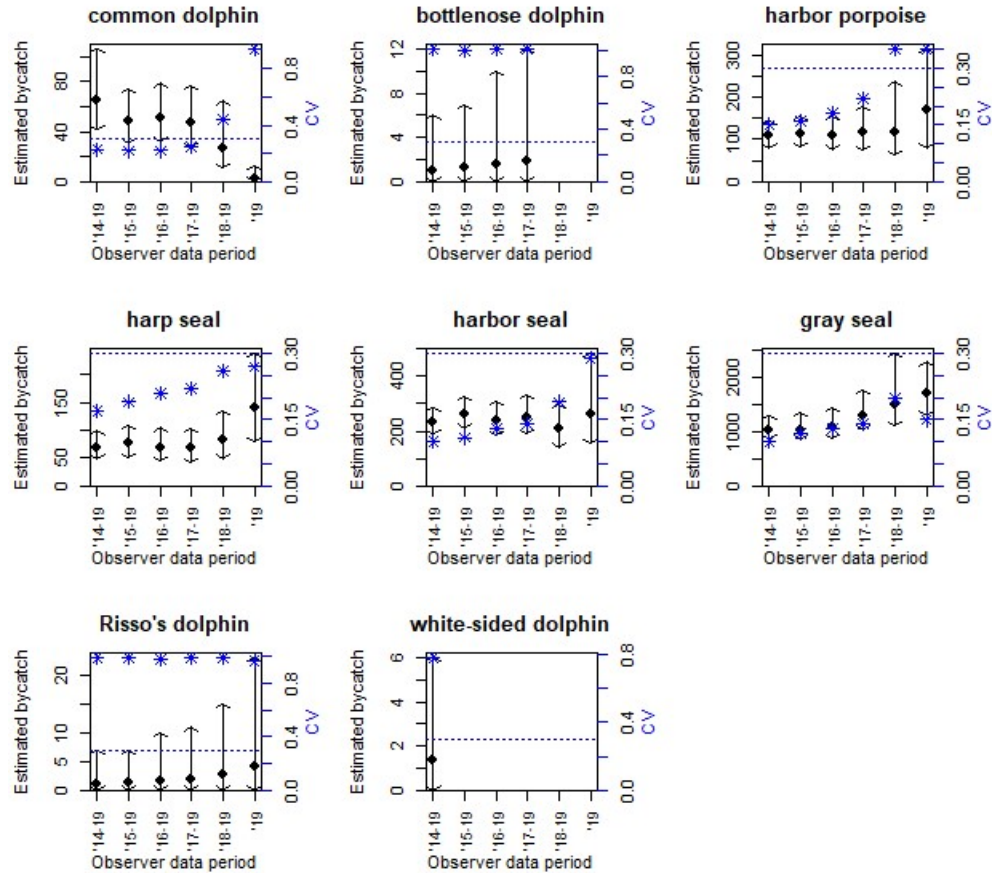


Figure A1. Total bycatch estimates for 2020 New England gillnet fishery derived with bycatch rates based on different time periods of observer data. The left y-axis, black dots, and black CIs are for the estimated bycatch in 2020 given observer data from different time periods (shown along the x axis). Blue asterisks show the CV of each bycatch estimate, and the blue dashed line is at CV=0.3. The CVs correspond to the right y-axis.

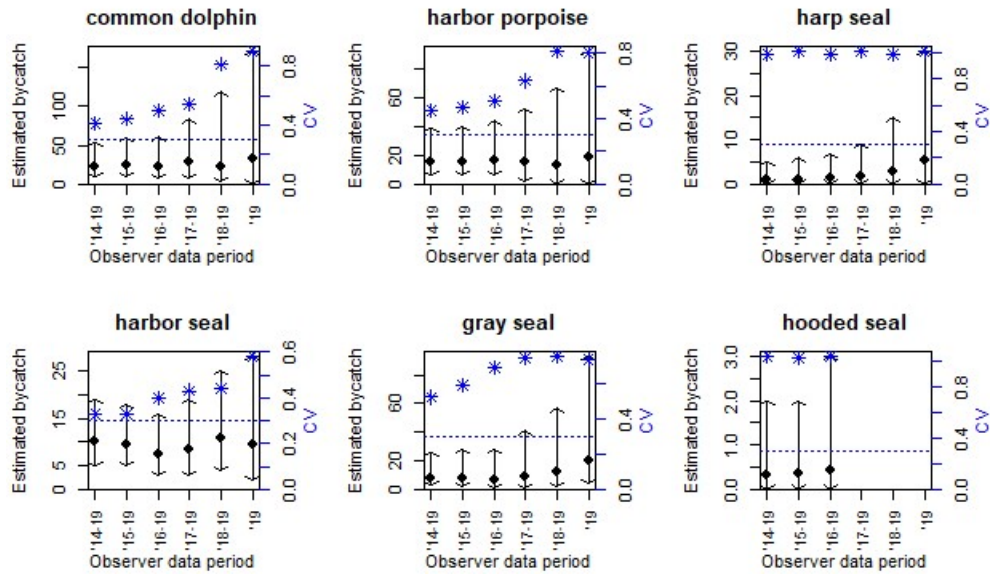


Figure A2. Total bycatch estimates for 2020 Mid-Atlantic gillnet fishery derived with bycatch rates based on different time periods of observer data. The left y-axis, black dots, and black CIs are for the estimated bycatch in 2020 given observer data from different time periods (shown along the x axis). Blue asterisks show the CV of each bycatch estimate, and the blue dashed line is at CV=0.3. The CVs correspond to the right y-axis.

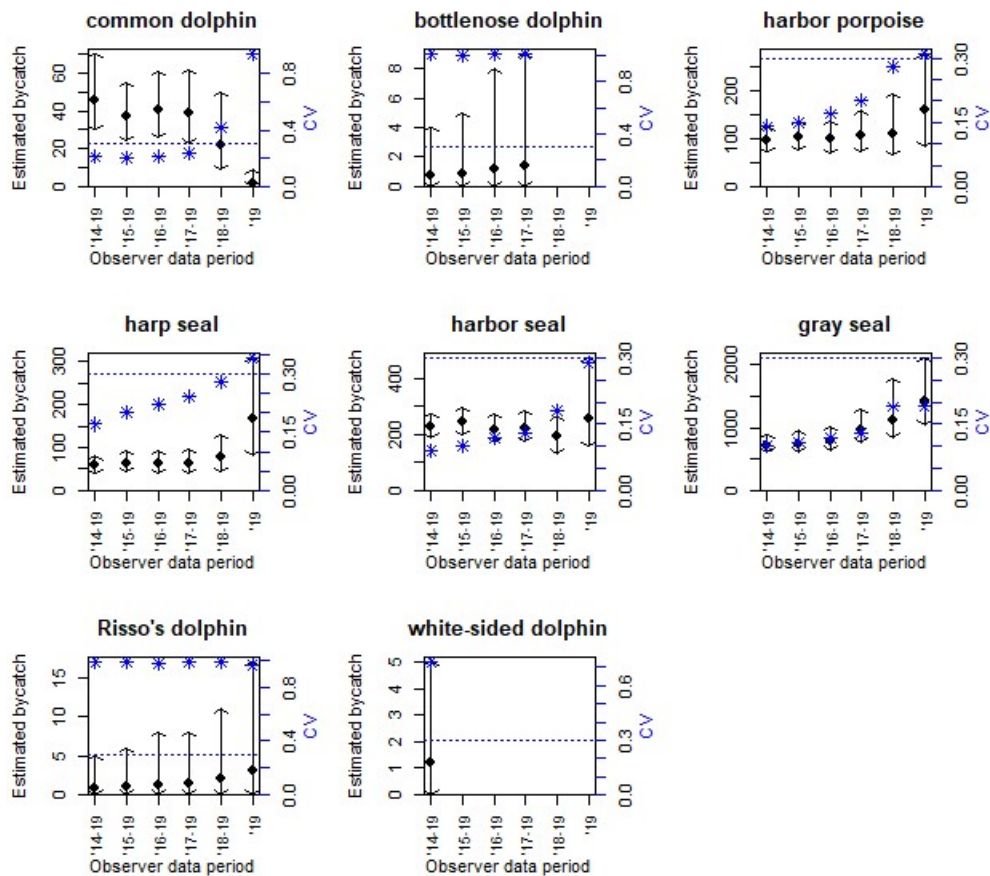


Figure A3. Total bycatch estimates for 2021 New England gillnet fishery derived with bycatch rates based on different time periods of observer data. The left y-axis, black dots, and black CIs are for the estimated bycatch in 2021 given observer data from different time periods (shown along the x axis). Blue asterisks show the CV of each bycatch estimate, and the blue dashed line is at CV=0.3. The CVs correspond to the right y-axis.

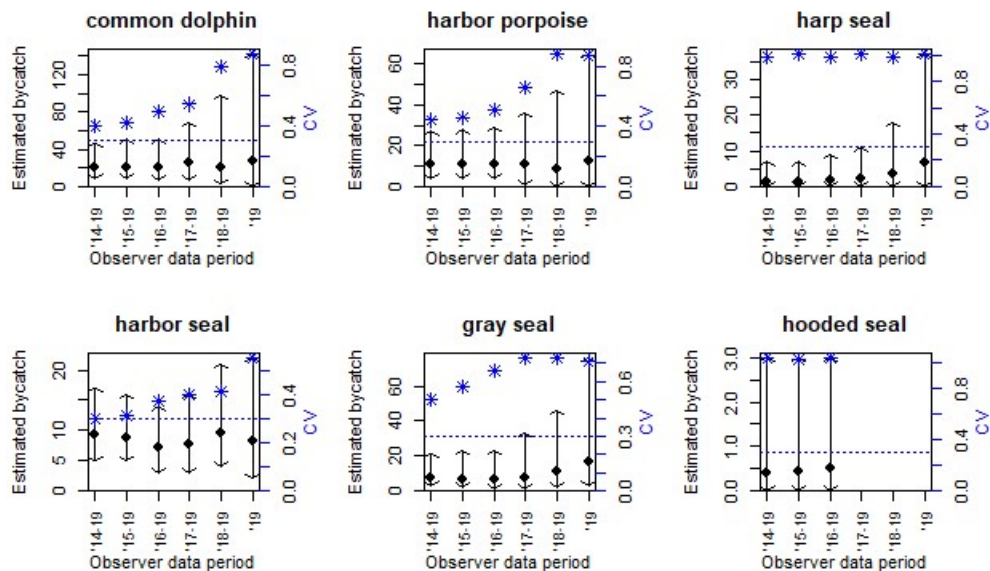


Figure A4. Total bycatch estimates for 2021 Mid-Atlantic gillnet fishery derived with bycatch rates based on different time periods of observer data. The left y-axis, black dots, and black CIs are for the estimated bycatch in 2021 given observer data from different time periods (shown along the x axis). Blue asterisks show the CV of each bycatch estimate, and the blue dashed line is at CV=0.3. The CVs correspond to the right y-axis.

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